

# APPLICATION UNDER UNITED STATES PATENT LAWS

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Invention: DISPLAY APPARATUS OF INJECTION MOLDING MACHINE

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This is a:

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- ☐ Continuing Application
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- ☐ PCT National Phase Application
- ☐ Design Application
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  - in App. No. \_\_\_\_\_ / \_\_\_\_\_
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## SPECIFICATION

TITLE OF THE INVENTION

DISPLAY APPARATUS OF INJECTION MOLDING MACHINE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the  
5 benefit of priority from the prior Japanese Patent  
Applications No. 2002-314575, filed October 29, 2002;  
and No. 2003-335394, filed September 26, 2003, the  
entire contents of both of which are incorporated  
herein by reference.

10 BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a display  
apparatus of an injection molding machine, which  
displays various settings of molding conditions and  
15 monitoring values of an injection molding machine.

2. Description of the Related Art

In a display apparatus which functions as a human-  
machine interface of a conventional injection molding  
machine, it is well known (Jpn. Pat. Appln. KOKAI  
20 Publication No. 2001-145947) that a display screen of a  
display unit is divided into two sections. One of the  
two sections is used as a main screen, and the other is  
used as a sub-screen. The main screen displays the  
screen display data required to set the molding  
25 conditions of an injection molding machine and the  
monitoring data from an injection molding machine, and  
the sub-screen displays various data including the

monitoring data, which are to be displayed at the appropriate times independently of the main screen, so that the molding conditions and the operating status of an injection molding machine can be efficiently set and confirmed.

5 An operator of a conventional display apparatus writes a memo and sticks it on the frame of the apparatus or writes it on a message board, when there are important items concerning an injection molding machine that is set and monitored by that display apparatus, or there are matters to be informed to the next operator who takes over the operation.

10 In a plant where two or more injection molding machines are operated, when the operators of the display apparatus connected to the injection molding machines communicate with each other, the operators must not leave their display apparatus, and they use an extension telephone or send a messenger. Otherwise, the operators communicate by electronic mail through personal computers.

20 However, when the operator writes a memo and sticks it on the apparatus frame, an adhesive tape may peel off and the memo may be lost. There is another problem that the portion where an adhesive tape is stuck is easily soiled. When a message board is used, the message board must be set near the display apparatus. Further, when the operators communicate to

one another, a communication device such as a telephone and a personal computer becomes necessary.

To solve these problems, it is considered to use software which sticks an electronic label on the display apparatus connected through the network, for example, to make communication among the operators. However, if an electronic label is stuck on the display screen, the information displayed in the screen is hidden by the label, causing an error in setting and monitoring the injection machine.

#### BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide a display apparatus of an injection molding machine, which permits certain transfer of information among the operators by using a display screen effectively without causing an error during setting and monitoring the injection molding machine.

According to one aspect of the present invention, there is provided a display apparatus of an injection molding machine, which functions as a human-machine interface, comprising an input unit which inputs text information as electronic data, a memory which stores the electronic data of the text information entered from the input unit, an instruction unit which instructs to display the text information, and a display control means which displays the text information electrified and stored in the memory in the

display screen according to the instruction from the instruction unit.

Additional objects and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out hereinafter.

10 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 a block diagram showing a system configuration of an embodiment of the present invention;

20 FIG. 2 is a schematic diagram showing an example of a screen of a display unit in the embodiment;

FIG. 3 is a schematic diagram showing a configuration of a keyboard of the display unit in the embodiment;

25 FIG. 4 is a block diagram showing a configuration of essential units of an operation panel controller in the embodiment;

FIG. 5 is a diagram showing a primary memory area formed in the memory of the operation panel controller;

FIGS. 6A to 6E are diagrams showing a configuration of a record stored in each file area of the memory;

FIG. 7 is a flowchart showing the primary steps of the memo key operation executed by the main control unit of the operation panel controller;

FIG. 8 is a flowchart showing concretely the message memo creating process in the memo key operation;

FIG. 9 is a flowchart showing the primary steps of the mail key operation executed by the main control unit of the operation panel controller;

FIG. 10 is a flowchart showing concretely the sending mail creating process in the mail key operation;

FIG. 11 is a flowchart showing concretely the mail sending process in the sending mail creating process;

FIG. 12 is a flowchart showing the primary steps of the mail receiving process executed by the main control unit of the operation panel controller;

FIG. 13 is a flowchart showing the primary steps of the timer interrupting process executed by the main control unit of the operation panel controller;

FIG. 14 is a view showing an example of a memo display screen;

FIG. 15 is a view showing an example of a character input panel;

FIG. 16 is a view showing an example of a mail display screen;

5           FIG. 17 is a view showing an example of a mail sending screen;

FIG. 18 is a view showing a display example of a memo display area;

10           FIG. 19 is a view showing a display example of a mail display area;

FIG. 20 is a view showing an example of not dividing the display screen of the display unit; and

FIG. 21 is a view showing an example of diving the display screen of the display unit into three sections.

15           DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the present invention will be explained hereinafter with reference to the attached drawings.

20           FIG. 1 is a block diagram showing the system configuration of an embodiment of the present invention. For a plurality of injection molding machines 1A - 1N, injection molding machine controllers 2A - 2N, which control the molding operation according to the predetermined molding conditions, and display apparatus 3A - 3N, which function as a human-machine  
25           interface, are provided. Each of the display apparatus 3A - 3N consists of an operation panel 4 and an

operation panel controller 5.

The operation panel 4 is provided with a display unit 6 having a screen display such as a CRT display and a liquid crystal display, and a keyboard 7 having a plurality of key buttons. Over almost the whole area of the screen of the display unit 6, a touch panel sensor 8 is provided. The screen is divided into two sections in the horizontal direction in the upper half area parted by the center. The lower wide area is used as a main screen area M, and the upper narrow area is used as a sub-screen area S. The main screen area is composed as an area to set various values concerning the molding conditions of the corresponding injection machines 1A - 1N, and to display the monitoring data. The sub-screen area S is composed as a selector buttons area to select various data to be displayed at the appropriate times in the corresponding sub-screen.

FIG. 2 is an example of the screen of the display unit 6. The main screen area M displays the menu for setting the conditions of the injection/weighing process and monitoring the operation. The sub-screen S displays various sub-screen selector buttons, such as, "CURRENT VALUE", "TEMPERATURE", "MONITOR TABLE", "PRODUCTION", "OPERATION PROCESS", "SETTING HISTORY", "I/O MONITOR", "POWER-ON RATE", "CALCULATOR", "MEMO", "MAIL" and "NOT DISPLAY". When these buttons are touched, the corresponding screen will be displayed in



the sub-screen area S.

The keyboard 7 of the operation panel 4 has the buttons "CLAMP MOLD/EXTRUDE", "INJECT/WEIGH", "TEMPERATURE", "PRODUCTION", "MONITOR", "DIAGNOSIS",  
5 "SUPPORT", "RECORD", "SCREEN GUIDE", "ALARM", "SET" and "DISPLAY". When these buttons are touched, the corresponding screen will be displayed in the main screen area M.

The operation panel controller 5 is connected to  
10 the corresponding injection molding machine controllers 2A - 2N to permit two-way data communication. Each operation panel controller 5 is connected with predetermined protocol through a LAN (Local Area Network) 9 to permit data communication. The LAN 9 is  
15 connected with a network server 10. The network server 10 functions as a repeater between a public line, such as a public telephone network, or a private line and the LAN 9.

FIG. 4 is a block diagram showing the configura-  
20 tion of the essential units of the operation panel controller 5. The operation panel controller 5 of the display apparatus 3A - 3N has the same configuration. Namely, the operation panel controller 5 comprises a main control unit 11 such as a CPU (Central Processing  
25 Unit), a memory 12 such as a ROM (Read Only Memory) and a RAM (Random Access Memory), a clock 13 which keeps the current date and time, a LAN interface 14 which

controls the data communication made through the LAN 9,  
an injection molding machine interface 15 which  
controls the data transfer made between the controllers  
2A - 2N of the corresponding injection molding machines  
1A - 1N, a signal input unit 16, and a VRAM (Video  
Random Access Memory) 17. The main control unit 11 is  
electrically connected with the memory 12, the clock  
13, the LAN interface 14, the injection molding machine  
interface 15, the signal input unit 16 and the VRAM 17.

The signals from the touch panel sensor 8 and  
keyboard 7 are inputted to the signal input unit 16.  
The VRAM 17 stores the screen data displayed in the  
main screen area M and sub-screen area S of the display  
unit 6.

The operation panel controller 5 configured as  
above edits the information corresponding to the  
touched key button of the keyboard 7 based on the  
injection molding machine controllers 2A - 2N connected  
to the injection molding machine interface 15, and  
displays them in the main screen area M of the display  
unit 6. The operation panel controller 5 also displays  
the information corresponding to the touched sub-screen  
selector button in the sub-screen area S of the display  
unit 6.

When the "MEMO" button B1 of the sub-screen  
selector button is touched, the message memo is  
displayed in the sub-screen area S. When the "MAIL"

button B2 is touched, an electronic mail is displayed in the sub-screen area S. It is to be noted that the message memo is the text information created as electronic data on the operation panel 4, and is made displayable on the operation panel 4. For example, it is used to write down the items that the operator of the operation panel 4 must not neglect to perform, or write down the items to be notified to the next operator who succeeds the operation. The electronic mail means the text information created as electronic data on the operation panel 4 and made displayable on the operation panel 4 when it is sent to the other display apparatus 3A - 3N connected through the LAN 9 or communication equipment such as a personal computer connected through the network server 10. It is used for example when exchanging information between the operators who operate the display apparatus 3A - 3N of the injection molding machines 1A - 1N and the other staff of a plant.

20           In the operation panel controller 5, various memory areas are formed in the memory 12 to execute the above-mentioned message memo function and electronic mail function, which include a main screen display data memory 21, a sub-screen display data memory 22, a counter memory 23 of a display pointer P, a message memo file 24, a received mail file 25, a sending mail file 26, a memo number X counter memory 27, a received

mail number Y counter memory 28, a sending mail number Z counter memory 29, a deleted log file 30, an address management file 31, and a plat staff management file 32.

5           The main screen display data memory 21 mentioned here means the area storing the main screen display data displayed in the main screen area M of the display unit 6. The sub-screen data memory 22 means the area storing the sub-screen display data displayed in the  
10           sub-screen area S of the display unit 6.

          The message memo file 24 is, as shown in FIG. 6A, the area to store a message memo record comprising a record number or a serial number beginning with 1, a creation date/time of a message memo, a data/time to  
15           display a message memo (a display start time), and a message memo text, in the ascending order of the record number. The total number of the records stored in the message memo file 24 is counted by the memo number  
          counter X of the counter memory 27.

20           The received mail file 25 is, as shown in FIG. 6B, the area to store a received mail record comprising a record number which is a serial number beginning with 1, a date/time to receive an electronic mail, a time to display the electronic mail (a display start time), a  
25           sender of an electronic mail, a title of an electronic mail and a mail text, in the ascending order of the record number. The total number of the records stored

in the received mail file 25 is counted by the received mail counter Y of the counter memory 28.

5       The sending mail file 26 is, as shown in FIG. 6C, the area to store a sending mail record comprising a record number which is a serial number beginning with 1, a date/time to create an electronic mail, a destination address of an electronic mail, a time to display an electronic mail (a display start time), a sender of an electronic mail, a received mail record  
10       comprising a title of an electronic mail and a mail text, in the ascending order of the record number. The total number of the records stored in the sending mail file 26 is counted by the sending mail counter Z of the counter memory 29.

15       The above-mentioned deleted log file 30 is the area to save the records deleted from the message memo file 24, the received mail file 25 and the sending mail file 26.

20       The address management file 31 is, as shown in FIG. 6D, the area to store an address management record comprising a record number which is a serial number beginning with 1, names of injection molding machines assigned previously to the injection molding machines 1A - 1N, MAC addresses that are the specific transfer  
25       identification addresses set previously to the LAN interface 14 of the operation panel controller 5 corresponding to the injection molding machines

1A - 1N, and an IP address, in the ascending order of the record number.

5 The plant staff management file 32 is, as shown in FIG. 6E, the area to store a staff code comprising a record number which is a serial number beginning with 1, a unique staff code assigned to each staff member, and the name and section of each staff, in ascending order of record number.

10 The main control unit 11 of the operation panel controller 5 is programmed to execute the memo key function shown in the flowchart of FIG. 7 to realize the message memo function of the display apparatus 3A - 3N, when the depression of the "MEMO" button B1 displayed in the sub-screen area S of the display unit  
15 6 is detected by the signal inputted from the touch panel sensor 8 to the signal input unit 16.

As a first step (hereinafter referred to as ST), the main control unit 11 reads the memo display screen data from the sub-screen display data memory 22, and  
20 displays a memo display screen 40 configured as shown in FIG. 14, in the sub-screen area S of the display unit 6.

The memo display screen 40 comprises a memo display area 41 to display the memo creation date/time  
25 and a message text, a CREATE key 42, a NEXT key 43, a BACK key 44, and a DELETE key 45. The memo display area 41 permits the operator to see even a long message

by scrolling the screen by a scroll bar. The "P/X" on the right side of the memo display area 41 indicates that the message memo displayed in the memo display area 41 is the message memo of the Pth (the value of the display pointer P) record among the total number X (the value of the memo number counter X) of the message memo records stored in the message memo file 24.

Next, at ST2, the main control unit 11 checks whether the memo number counter X is larger than "0". When the memo number counter X is larger than "0", the main control unit sets the display pointer P to "1", as ST3. As ST4, the main control unit reads the 1st message memo record from the message memo file 24, and display the creation data/time of this record and the message memo text in the memo display area 41. Therefore, the operator of the operation panel 4 can display the message memo of the first record stored in the message memo file 24 in the memo display area 41 of the sub-screen area S, by touching the "MEMO" button B1.

The "MEMO" button B1 functions as a commander to command to display text information. The message memo file 24 functions as a memory to store the electronic data of text information. The main control unit 11 functions as a display controller to display the text information electrified and stored in the memory in the sub-screen area S, according to the command from the

commanding means. The text information mentioned here means the information represented by characters.

When the memo number counter X is "0" in ST2, the steps ST3 and ST4 will not be executed.

5           Next, the main control unit 11 waits for the sub-screen area S to be touched at ST5. When the touching of any part of the sub-screen S is detected by the signal from the touch panel sensor 8 input to the signal input unit 16, the main control unit 11 checks  
10 whether any of the keys 42 - 45 of the memo display screen is touched at ST6 - ST9, or the other area is touched. When the area other than the keys 42 - 45 is touched, the main control unit 11 resets the sub-screen area S to the sub-screen selector button display  
15 screen, as shown in FIG. 2, at ST10, and terminates the memo key operation. Therefore, the operator can finish the display of message memo by touching the sub-screen area S other than the keys 42 - 45, after confirming the message memo.

20           Contrarily, when the NEXT key 43 is touched, the main control unit 11 checks as ST11 whether the value of the display pointer P is larger than the value of the memo number counter X. When the value of the display pointer P is smaller than the value of the memo  
25 number counter X, the main control unit increases the value of the display pointer P by "1", at ST12, returns to ST4, reads the Pth message memo record from the



message memo file 24, and displays the creation  
date/time of this record and the message memo text in  
the memo display area 41. When the value of the  
display pointer P is larger than the value of the memo  
5 number counter X, the main control unit returns to ST4  
without changing the value of the display pointer P.  
Therefore, the operator can sequentially display in  
ascending order (in the order of the creation date and  
time) the message memo stored in the message memo file  
10 24 by touching the NEXT key 43.

When the BACK key 44 is touched, the main control  
unit 11 checks at ST13 whether the value of the display  
pointer P is smaller than "1". When the value of the  
display pointer P is larger than "1", the main control  
15 unit decreases the value of the display pointer P by  
"1", at ST14, returns to ST4, reads the Pth message  
memo record from the message memo file 24, and displays  
the creation date/time of this record and the message  
memo text in the memo display area 41. When the value  
20 of the display pointer P is smaller than "1", the main  
control unit returns to ST4 without changing the value  
of the display pointer P. Therefore, the operator can  
sequentially display in descending order (in the  
reverse order of the creation date and time) the  
25 message memo stored in the message memo file 24 by  
touching the BACK key 44.

When the DELETE key 45 is touched, the main

control unit 11 deletes the Pth message memo record  
from the message memo file 24 at ST15. Then, the main  
control unit sequentially shifts the message memo  
records on and after the (P + 1)th upward (in the  
5 smaller number direction) at ST16. Thereafter, the  
main control unit decreases the value of the memo  
number counter X by "1", as ST17, moves to ST18, and  
checks whether the value of the memo number counter X  
is larger than "0". When "Yes" is judged at ST18, flow  
10 moves to ST4, when "No" is judged at ST18, flow moves  
to ST5. Thereafter, the operator can delete the  
message memo record displayed in the memo display area  
41 from the message memo file 24 by touching the DELETE  
key 45. After the record is deleted, the message memo  
15 of the record stored next to that record will be  
displayed in the memo display area 41. The deleted  
message memo record is saved in the deleted log file  
30, and can be checked later.

When the CREATE key 42 is touched, a message memo  
20 creation process is executed as concretely shown in the  
flowchart of FIG. 8. Namely, the main control unit 11  
displays a character input panel 50 as shown in FIG. 15  
over the main screen area M.

The character input panel 50 comprises function  
25 keys of ADDRESS key 51, TEXT key 52, DISPLAY TIME key  
53 and CLOSE key 54, and character keys 55 including  
symbols, figures and alphabets. The character keys 55

can be changed to a HIRAGANA keyboard layout by touching the KANA key 56. The character input panel 50 includes an input information display area 57 to display the input information of the character keys 55.

5           Next, at ST22 - ST25, the main control unit 11 waits for depression of any function key 51 - 54 of the character input panel 50. When the depression of the ADDRESS key 51 is detected by the signal inputted from the touch panel sensor 8 to the signal input unit 16,  
10           the main control unit jumps to ST66 of creating a sending mail (FIG. 10), as explained later.

Contrarily, when the depression of a DISPLAY TIME key 53 is detected, the main control unit 11 executes the display time input process at ST26. This process  
15           is to take in the digits (hour: minute) entered from the character keys 55 as a message memo display start time.

When the depression of the TEXT key 52 is detected, the main control unit 11 executes the text  
20           input process at ST27. This process is to take in the character, digit and symbol entered from the character keys 55, as a message memo text.

Contrarily, when the depression of the CLOSE key 54 is detected, the main control unit 11 edits a  
25           message memo data having creation date/time, display time and memo text, at ST28. The creation date/time is the current date/time indicated by the clock 13. The

display time is the time of the time data when the time data has been taken in by the display time input process of ST26, and "0" otherwise. The memo text is the character information when the character information has been taken in by the text input process of ST27, and causes an edition error otherwise.

The main control unit 11 checks at ST29 whether the message memo data is edited or not. When the message memo data is edited, the main control unit at ST30 and ST31 sequentially shifts the message memo records on and after the 1st record in the message memo file 24 downward (in the larger number direction), stores the edited message memo data in the empty 1st record position, and increases the value of the memo number counter X by "1", at ST32. When the message memo data is not edited, the steps ST30 - ST32 will not be executed. Thereafter, the main control unit clears the character input panel 50, and returns to the memo key process (FIG. 7) of ST2.

Therefore, the operator can enter a message memo as electronic data from the character input panel 50 by touching the CREATE key 42 in the memo display screen 40. The message memo record is stored in the message memo file 24. The message memo text of the message memo record stored in the message memo file 24 is displayed in the memo display area 41 of the memo display screen 40, which is displayed in the sub-screen

area S. Therefore, the memo creator can check whether the memo contents are correct, by monitoring the memo display area 41.

5 The touch panel sensor 8 functions as an input unit to input text information as electronic data in relation to the message memo creating process of the main control unit 11.

Next, explanation will be given to the electronic mail function of the display apparatus 3A - 3N.

10 The main control unit 11 of the operation panel controller 5 is programmed to execute the mail key process shown in the flowchart of FIG. 9, when the depression of the MAIL button B2 displayed in the sub-screen area S of the display unit 6 is detected by the  
15 signal inputted from the touch panel sensor 8 to the signal input unit 16.

At a first step, the main control unit 11 reads the mail display screen data from the sub-screen display data memory 22, and displays a mail display  
20 screen 60, as shown in FIG. 16, in the sub-screen area S of the display unit 6.

The mail display screen 60 comprises a mail display area 61 to display the mail reception date/time, sender, title and text, and a CREATE key 62,  
25 a NEXT key 63, a BACK key 64, and a DELETE key 65. The mail display area 61 permits the operator to see even a long message by scrolling the screen by a scroll bar.

The "P/Y" on the right side of the mail display area 61 indicates that the received mail displayed in the mail display area 61 is the received mail of the Pth (the value of the display pointer P) record among the total number Y (the value of the received mail counter Y) of the received mail records stored in the received mail file 25.

Next, at ST42, the main control unit 11 checks whether the received mail counter Y is larger than "0". When the received mail counter Y is larger than "0", set the display pointer P to "1", as ST43. At ST44, the main control unit reads the 1st received mail record from the received mail file 25, and displays the creation data/time of this record, sender, title and mail text in the mail display area 61. Therefore, the operator can display received mail of the first record stored in the received mail file 25 in the mail display area 61 of the sub-screen area S, by touching the "MAIL" button B2.

When the received mail counter Y is "0" in ST42, the steps ST43 and ST44 will not be executed.

Next, at ST45, the main control unit 11 waits for the sub-screen area S to be touched. When the touching of any part of the sub-screen S is detected by the signal inputted from the touch panel sensor 8 to the signal input unit 16, the main control unit 11 checks whether any of the keys 62 - 65 of the memo display

screen 60 is touched, at ST46 - ST49, or the other area is touched. When the area other than the keys 62 - 65 is touched, the main control unit 11 resets the sub-screen area S to the sub-screen selector button display screen, at ST50, and terminates the mail key process. Therefore, the operator can finish the display of received mail by touching the sub-screen area S other than the keys 62 - 65.

Contrarily, when the NEXT key 63 is touched, the main control unit 11 checks at ST51 whether the value of the display pointer P is larger than the value of the received mail counter Y. When the value of the display pointer P is smaller than the value of the received mail counter Y, the main control unit increases the value of the display pointer P by "1", at ST52, returns to ST44, reads the Pth received mail record from the received mail file 25, and displays the received date/time of this record and the mail text in the mail display area 61. When the value of the display pointer P is larger than the value of the received mail counter Y, the main control unit returns to ST44 without changing the value of the display pointer P. Therefore, the operator can sequentially display in ascending order (in the order of the creation date and time) the received mail stored in the received mail file 25 by touching the NEXT key 63.

When the BACK key 64 is touched, the main control

unit 11 checks as ST53 whether the value of the display pointer P is smaller than "1". When the value of the display pointer P is larger than "1", the main control unit decreases the value of the display pointer P by "1" at ST54, returns to ST44, reads the Pth received mail record from the received mail file 25, and displays the creation date/time of this record and the mail text in the mail display area 61. When the value of the display pointer P is smaller than "1", the main control unit returns to ST44 without changing the value of the display pointer P. Therefore, the operator can sequentially display in descending order (in the reverse order of the creation date and time) the received mail stored in the received mail file 25 by touching the BACK key 64.

When the DELETE key 65 is touched, the main control unit 11 deletes the Pth received mail record from the received mail file 25 as ST55. Then, at ST56, the main control unit sequentially shifts the received mail records on and after the (P + 1)th upward (in the smaller number direction). Thereafter, the main control unit decreases the value of the received mail counter Y by "1", as ST57, moves to ST58, and checks whether the value of the received mail counter Y is larger than "0". If "YES" is judged at ST58, flow moves to ST44. If "NO" is judged at ST58, flow moves to ST45. Thereafter, the operator can delete the



received mail record displayed in the mail display area  
61 from the received mail file 25 by touching the  
DELETE key 65. After the record is deleted, the  
received mail of the record stored next to that record  
5 will be displayed in the mail display area 61.

When the CREATE key 62 is touched, a sending mail  
creation process will be executed as concretely shown  
in the flowchart of FIG. 10. Namely, the main control  
unit 11 displays a character input panel 50 over the  
10 main screen area M, at ST61, as in the message memo  
creation process of ST21.

Next, the main control unit 11 waits for  
depression of any function key 51 - 54 of the character  
input panel 50 at ST62 - ST65. When the depression of  
15 the ADDRESS key 51 is detected by the signal inputted  
from the touch panel sensor 8 to the signal input unit  
16, the main control unit performs the destination  
address input process, sender input process and title  
input process, at ST66 - ST68.

20 The destination address input process is the  
process of selecting and inputting an destination  
address information of a sending mail among the address  
information (MAC address, IP address) managed for each  
injection molding machine 1A - 1N by the address  
25 management file 31. It is also permitted to manually  
input the MAC address and IP address of other  
communication terminals connected through the network

server 10, or the E-mail address set for each individual.

5       The sender input process is the process that the sender reads his (her) section and name managed by the staff management file 32 by inputting the staff code. The title input process is the process of taking in the characters information entered by the character keys 55 as a title of a sending mail.

10       Contrarily, when the depression of the DISPLAY TIME key 53 is detected, the main control unit 11 executes the display time input process as ST69. This process is to take in the digits (hour: minute) entered from the character keys 55 as a sending mail display start time.

15       When the depression of the TEXT key 52 is detected, the main control unit 11 executes the text input process at ST70. This process is to take in the character, digit and symbol entered from the character keys 55 as a mail text.

20       Contrarily, when the depression of the CLOSE key 54 is detected, the main control unit 11 edits a sending mail data having creation date/time, destination address, display time, sender, title and mail text, at ST71. The creation date/time is the  
25       current date/time indicated by the clock 13. The display time is the time of the time data when the time data has been taken in by the display time input

process of ST69, and "0" otherwise. The destination address, sender and title are the characters information obtained by each of ST66 - ST69. The mail text is the characters information obtained by the text input process of ST70. The sender and title can be omitted, but an error is resulted when the characters information of the destination address and mail text are not taken in.

The main control unit 11 checks at ST72 whether the sending mail data is edited or not. When the sending mail data is not edited, the main control unit clears the character input panel 50, and returns to the mail key process (FIG. 9) of ST42.

When the sending mail data can be edited, the main control unit sequentially shifts the sending mail records on and after the 1st record in the sending mail file 26 downward (in the larger number direction), stores the edited sending mail data in the empty 1st record position, and increases the value of the sending mail counter Z by "1", at ST76. Therefore, the operator can enter a sending mail as electronic data from the character input panel 50 by touching the CREATE key 62 in the mail display screen 60. The created sending mail record is stored in the sending mail file 26.

The touch panel sensor 8 functions as an input unit to input text information as electronic data in

relation to the sending mail creating process of the main control unit 11.

Next, the main control unit 11 clears the character input panel 50, at ST77, and executes the mail sending process shown concretely in the flowchart of FIG. 11. First of all, the main control unit 11 reads the mail sending screen data from the sub-screen display data memory 22, and displays the mail sending screen 70 as shown in FIG. 17 in the sub-screen area S of the display unit 6.

The mail sending screen 70 comprises a mail display area 71 to display a sending mail reception date/time, sender, title and mail text, and the SEND key 76 in addition to the CRERATE key 72, NEXT key 73, BACK key 74, and DELETE key 75 of the mail display screen 60. The mail display area 71 permits the operator to see even a long message by scrolling the screen by a scroll bar. The "P/Z" on the right side of the mail display area 71 indicates that the sending mail displayed in the mail display area 71 is the sending mail of the Pth (the value of the display pointer P) record among the total number Z (the value of the sending mail counter Z) of the sending mail records stored in the sending mail file 26.

Next, the main control unit 11 sets the display pointer P to "1" at ST82, reads the Pth sending mail record from the sending mail file 26, at ST83, and

displays the creation date/time of this record, sender,  
title and mail text in the mail display area 71. Since  
the created sending mail is displayed in the mail  
display area 71 of the mail sending screen 70, the mail  
5 creator can check the mail contents by monitoring the  
mail display area 71.

Next, the main control unit 11 waits for any key  
72 - 76 of the mail sending screen 70 to be touched at  
ST84 - ST88. When the depression of the CREATE key 72  
10 is detected, the main control unit re-executes the  
sending mail creating process (FIG. 10). Therefore,  
the operator (the mail crater) can create a second  
sending mail by touching the CREATE key 72.

Contrarily, when the NEXT key 73 is touched, the  
15 main control unit 11 checks as ST89 whether the value  
of the display pointer P is larger than the value of  
the sending mail counter Z. When the value of the  
display pointer P is smaller than the value of the  
sending mail counter Z, the main control unit at ST90  
20 increases the value of the display pointer P by "1",  
returns to ST83, reads the Pth sending mail record from  
the sending mail file 26, and displays the creation  
date/time of this record, and mail text in the mail  
display area 71. When the value of the display pointer  
25 P is larger than the value of the sending mail counter  
Z, the main control unit returns to ST83 without chang-  
ing the value of the display pointer P. Therefore, the

operator can sequentially display the sending mails stored in the sending mail file 26 in the mail display area 71 in the ascending order (in the order of creation data and time) by touching the NEXT key 73.

5           When the BACK key 74 is touched, the main control unit 11 checks at ST91 whether the value of the display pointer P is smaller than "1" or not. When the value of the pointer P is larger than "1", the main control unit decreases the value of the display pointer P by  
10       "1", at ST92, returns to ST83, reads the Pth sending mail record from the sending mail file 26, and displays the creation date/time of this record and mail text in the mail display area 71. When the value of the display pointer P is smaller than "1", the main control  
15       unit returns to ST83 without changing the value of the display pointer P. Therefore, the operator can sequentially display the sending mails stored in the sending mail file 26 in the mail display area 71 in the descending order (in the reverse order of the creation  
20       date and time) by touching the BACK key 74.

          When the DELETE key 75 is touched, the main control unit 11 deletes the Pth sending mail record from the sending mail file 26, at ST93. Then, the main control unit sequentially shifts the sending mail  
25       records on and after the (P + 1)th upward (in the smaller number direction) at ST94. Thereafter, the main control unit decreases the value of the sending

mail counter Z by "1", at ST95, and checks as ST96 whether the value of the sending mail counter Z becomes "0". When the sending mail counter Z is larger than "1", return to ST83. When the sending mail counter Z is "0", the sending mail data does not exist, and return the sub-screen area S to the sub-screen selector button display screen, at ST97, and terminate the mail key process. Therefore, the operator can delete the sending mail record displayed in the mail display area 71 from the sending mail file 26 by touching the DELETE key 75. When no sending mail record remains after the sending mail is detected, the mail sending process is finished.

When the SEND key 76 is touched, at ST98, the main control unit sends all sending mail records stored in the sending mail file 26 to the other operation panel controller 5 or network server 10 through the LAN 9 (text information transmission unit). When sending of all sending mail records is finished at ST99, the main control unit deletes all sending mail records stored in the sending mail file 26, at ST100, and resets the sending mail counter Z to "0", at ST101. Thereafter, the main control unit returns the sub-screen area S to the sub-screen selector button display screen, and terminates the mail key process. Therefore, the operator can send a created sending mail to each section via the LAN 9 by touching the SEND key 76.

The mail records deleted from the received mail file 25 and the sending mail file 26 are saved in the deleted log file 30, and they can be confirmed later.

Further, the main control unit 11 of the operation panel controller 5 is programmed to execute the process shown in the flowchart of FIG. 12, when receiving an electronic mail data addressed to a self-address through the LAN 9 by the LAN interface 14. Namely, the main control unit 11 shifts sequentially the received mail records on and after the 1st record of the received mail file 25 downward (in the larger number direction) at ST111 and ST112, stores the received electronic mail data in the empty 1st record position, and increases the received mail counter Y by "1", at ST113.

Next, the main control unit 11 displays the mail display area 61 over the current screen displayed in the sub-screen area S, at ST114, as shown in FIG. 19. Then, the main control unit sets the display pointer P to "1", at ST115, reads the Pth received mail record from the received mail file 25, at ST116, and displays the reception date/time of this record, sender, title and mail text in the mail display area 61.

Then, at ST117, the main control unit waits for any one part of the sub-screen area S to be touched. When the depression of any part of the sub-screen area S is detected by the signal inputted from the touch



panel sensor 8 to the signal input unit 16, the main control unit 11 deletes the mail display area 61 from the sub-screen area S, and terminates the mail receiving process.

5           Therefore, when an electronic mail is sent from other unit through the LAN 9, the reception data/time of the received mail, sender, title and mail text are immediately and automatically displayed in the sub-screen area S of the display unit 6 of the operation  
10 panel 4. The operator can restore the sub-screen area S by touching the sub-screen area S, after checking the mail.

          The LAN interface 14 functions as a text information receiver to receive the electrified text  
15 information transferred through the network (LAN 9). The main control unit 11 functions as a display controller to display the text information received by the receiving means in the sub-screen area S.

          Further, the main control unit 11 of the operation  
20 panel controller 5 is programmed to execute the timer interruption process shown in the flowchart of FIG. 13, corresponding to the timer interruption signal occurred whenever the time of the clock 13 elapses 1 minute, for example. The timer interruption signal occurrence  
25 interval is not limited to 1 minute, and is changeable appropriately.

          After starting the interruption process, the main

control unit 11 first reads the current time by the clock 13 which functions as a clocking means, at ST121.

Next, at ST122, the main control unit 11 searches the message memo file 24 for the message memo record  
5 (by a search unit) whose display time is identical to the current time. When the message memo record with the same display time as the current time is detected (YES in ST123), the main control unit 11 displays the memo display area 41 over the current screen displayed  
10 in the sub-screen area S, at ST124, as shown in FIG. 18, and displays the creation time and text of the message memo record whose display time is the same as the current time, in the memo display area 41 (a time display control unit).

15 Thereafter, the main control unit 11 waits for any one part of the sub-screen area S to be touched as ST125. When the depression of any part of the sub-screen area S is detected by the signal inputted from the touch panel sensor 8 to the signal input unit 16,  
20 the main control unit 11 goes to the process of ST126. When the message memo record whose display time is the same as the current time is not found (NO in ST123), the main control unit immediately goes to the process of ST126.

25 In ST126, the main control unit 11 searches the received mail file 25 for the received mail record whose display time is identical to the current time.

When the received mail record with whose display time is the same as the current time is detected (YES in ST127), the main control unit 11 displays the mail display area 61 over the current screen displayed in the sub-screen area S, at ST128, as shown in FIG. 19, and displays the creation time and text of the received mail record whose display time is the same as the current time in the mail display area 61.

Thereafter, the main control unit 11 waits for any one part of the sub-screen area S to be touched as ST129. When the depression of any part of the sub-screen area S is detected, the main control unit 11 goes to the process of ST130. When the received mail record whose display time is the same as the current time is not found (NO in ST127), the main control unit immediately goes to the process of ST130.

In ST130, the main control unit 11 clears the memo display area 41 from the sub-screen area S. By the above operation, the main control unit 11 terminates the timer interruption process.

Therefore, if a memo creator sets a desired display time when creating a message memo by operating the character input panel 50 displayed in the display unit 6 of the operation panel 4, the message memo contents will be automatically displayed in the sub-screen area S of the display unit 6 of the same operation panel 4 at the set time. Likewise, when the

set time expires, the mail contents will be automatically displayed in the sub-screen area S of the operation panel 4 at the destination of the mail.

5       The contents of the message memo shown in FIG. 18, for example, indicate that the material will be changed at 5:30 p.m. However, if the display time of this memo is set to 3:00 p.m. of the same day, the operator certainly remembers the next operation process at 3:00 p.m., increasing the production efficiency.

10       If the display end time can be set as well as the display start time, it will be possible to automatically display and clear the contents at the specified time of a message memo or electronic mail.

15       According to the embodiment explained hereinbefore, since the display apparatus 3A - 3N, which function as a human-machine interface of the injection molding machines 1A - 1N, are provided with a message memo function which can display the text information created as electronic data on the operation  
20       panel 4, the operator can securely transfer the important items concerning the injection molding machines 1A - 1N set and monitored by the display apparatus 3A - 3N, and the messages to the next operator who takes over the operation.

25       Further, since the display apparatus 3A - 3N are also provided with the electronic mail function which sends the text information created as electronic data

to an external system through the LAN9, and displays the electronic text information received through the LAN9 in the operation panel 4, the operators of the display apparatus 3A - 3N connected to the injection molding machines 1A - 1N can securely transfer the messages to one another.

In this case, the contents of message memo and received mail are displayed not in the main screen area M of the display unit 6, which is used to set the values of the molding conditions of the injection molding machines 1A - 1N, and display the monitoring data, but in the sub-screen S, which displays the selector buttons screen that is used less frequently, there is no possibility of causing trouble in setting and monitoring the injection molding machines 1A - 1N.

In the embodiment, when the ADDRESS button 51 of the character input panel 50 is touched in the message memo creating process of FIG. 8, the main control unit is programmed to jump to the process of ST66 in the sending mail creating process of FIG. 10. Therefore, it is possible to convert the text information inputted as a message memo into an electronic mail by inputting a destination address, sender and title, and send it to other display apparatus 3A - 3N.

In the above embodiment, the message memo records on and after the first record in the message memo file 24 are sequentially shifted downward (in the larger

number direction) in ST30 and ST31 of the message memo  
creating process shown in FIG. 8, the edited message  
memo data is stored in the empty first record position,  
and the memo number counter X is increased by "1" in  
5 ST32. The message memo record shifting process can be  
omitted by storing the edited message memo data in the  
Xth record position in the message memo file 24 after  
increasing the memo number counter X by "1". In this  
case, by setting the display pointer P not to "1" but  
10 "X" in ST3 of the memo key process of FIG. 7, the  
created message memo can be displayed in the memo  
display area 41. In this case, the message memos  
stored in the message memo file 24 are sequentially  
displayed in the order of older creation date/time when  
15 the NEXT key 43 is touched, and the message memos  
stored in the message memo file 24 are sequentially  
displayed in the order of younger creation date/time  
when the BACK key 44 is touched.

Likewise, in ST74 and ST75 of the sending mail  
20 creating process of FIG. 10, the sending mail records  
on and after the first record of the sending mail file  
26 are sequentially shifted downward (in the larger  
number direction), the edited sending mail data is  
stored in the empty first record position, and the  
25 sending mail counter Z is increased by "1" in ST76.  
However, the sending mail record shifting process may  
be omitted by storing the created sending mail data in

the Zth record position in the sending mail file 26,  
after increasing the sending mail counter Z by "1". In  
this case, the created sending mail can be displayed in  
the mail display area 71 by setting the display pointer  
5 P not to "1" but "Z" in ST43 of the mail key process of  
FIG. 9. In this case, the sending mails stored in the  
sending mail file 26 are sequentially displayed in the  
order of older creation date/time when the NEXT key 43  
is touched, and the sending mails stored in the sending  
10 mail file 26 are sequentially displayed in the order of  
younger creation date/time when the BACK key 44 is  
touched.

Further, in ST111 and ST112 of the received mail  
creating process of FIG. 12, the received mail records  
15 on and after the first record of the received mail file  
25 are sequentially shifted downward (in the larger  
number direction), the received mail data is stored in  
the empty first record position, and the received mail  
counter Y is increased by "1" in ST113. However, the  
20 received mail record shifting process can be omitted by  
storing the created sending mail data in the Yth record  
position in the received mail file 25 after increasing  
the received mail counter Y by "1". In this case, the  
received mail can be displayed in the mail display area  
25 61 by setting the display pointer P not to "1" but "Y"  
in ST115.

Further, in the embodiment, the display screen of

the display unit 6 is divided into two sections, but the dividing can be omitted as shown in FIG. 20. In this case, the contents displayed in the display screen is an always-displayed main screen M described in the above-mentioned embodiment and a sub-screen S displayed in another window in response to a request.

Still further, in the above embodiment, the display screen of the display unit 6 is divided into two sections, but the screen can be divided into three or more sections. A specific one of the divided sections can be used as a text information display screen to display text information.

For example, FIG. 21 shows an example of dividing the display screen of the display unit 6 into three sections, a main screen M, a first sub-screen S1 and a second sub-screen S2. When the display screen is divided into three sections like this, the display contents of the main screen M are the same as those of the main screen M explained in the above-mentioned embodiment, the display contents of the first sub-screen S1 are the same as those of the sub-screen S explained in the above-mentioned embodiment (except the display of text information), and the second sub-screen S2 is to be used as a specific display screen to display text information.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore,



the invention in its broader aspects is not limited to  
the specific details and representative embodiments  
shown and described herein. Accordingly, various  
modifications may be made without departing from the  
5 spirit or scope of the general inventive concept as  
defined by the appended claims and their equivalents.